3M Personal Safety Division
3M™ QUESTemp° ™ Heat Stress Monitors

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QUESTemp° 34 and QUESTemp° 36 User Manual

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Introduction

The QUESTemp° 34/36 models are portable heat stress monitors that are designed to be rugged, easy-to use instruments to quickly and accurately assess the potential for individual heat stress based on environmental conditions.

QUESTemp° Models

The QUESTemp° 34 and QUESTemp° 36 models measure and calculate the dry bulb temperature, wet bulb temperature, globe temperature, WBGT indoor index, WBGT outdoor index, relative humidity, and Heat Index or Humidex. These models support RS-232 communications and works with the optional software analysis program, 3M™ Detection Management Software (DMS).

With the QUESTemp° 36, you have the capability to display stay times in order to manage work/rest regimens. Guidance is based on the screening criteria for heat stress as defined in the ACGIH TLV Handbook, U.S. Navy PHEL charts, and EPRI Action Limits. (Please see Appendix B for detailed chart information.)

An additional feature with the QUESTemp° 36 is an optional detachable air-probe for measuring air velocity (wind speed) to determine appropriate levels of indoor thermal comfort monitoring.

Figure 1-1: QUESTemp° 36 model

Getting Started

Up and Running overview

1. Make sure the wet bulb wick is clean. Fill reservoir with distilled water.
   - See “check wick and fill natural wet bulb”, pg 5.

2. Place the QUESTemp° 34 & 36 in the work area in a safe location approximately 3.5 feet off the ground.

3. Power **On** the QUESTemp°34 & 36 and **check** the **battery**.
   - If the battery voltage displayed during the power-on sequence is less than or equal to 6.4 volts, replace or recharge the batteries.

4. Be aware that the sensors require 10 minutes to stabilize to a new environment.

5. In the main menu, View will be selected (an indicator arrow denotes the selected menu). Press the **I/O Enter key** to select.

6. Press the **Run/Stop key** to begin storing data.

7. Use the **Up/Down Arrow keys** to set the display to the desired items.

Keypad Operation

The unit operates using a keypad with 4 keys. The **I/O Enter key** responds when the key is released while all other keys respond when the key is pressed.

I/O Enter key

The unit turns on with a single key press. The unit turns off by holding the key down while a countdown of 3-2-1 occurs in the lower right corner of the display. This key is also used to select a mode (such as Setup or View) or enter setup changes.

Pressing and releasing the key while viewing temperatures causes the display to view the next available sensor bar (indicated in the upper right corner of the display).

Up Arrow key

Changes items appearing in the display. Scrolls up.

Down Arrow key

Changes items appearing in the display. Scrolls down.

Run Stop key

From the menu or view modes, pressing this key starts or stops the run mode. Pressing this key will exit the setup, print or reset modes.

Escaping/moving back one screen

If you are in the setup, print, reset, or calibration screens, you can press Run/Stop key to escape or move back one screen.

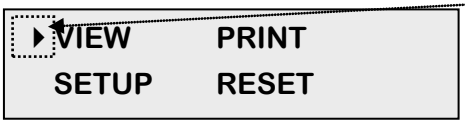
☑ ***NOTE:*** *the QUESTemp° 34 & 36 models have the same keypad. Figure 1-2 is an example of the QUESTemp° 36 model with the optional air-probe attachment.*

Figure 1-2: Keypad explained

Turning On/Off and Basic Operation

To quickly get you started with the QUESTempº 34 & 36 model, the following section explains how to turn on the instrument, run, and stop your session.

1. Press the **I/O Enter** key to **turn on**. Following the model and revision information displayed on the screen, the main menu will appear.



Indicator arrow
Indicates the selected menu option. Then press I/O enter to select or press up/down arrows

Figure 1-3: Main menu of the QUESTempº 34 & 36

2. Press the **I/O Enter** key (when view is selected) to access the measurement screens.
   - The Wet and Dry measurements screen will display. (See Figure 1-6, page 9 for screen example.)
3. To view different measurements, press the **Up** or **Down arrow** key to toggle through the views.

   ☑ ***NOTE:*** *There are 5-user selectable languages. If you see the fields such as Wet, Dry, WBGTi, and WBGTo this indicates the measurements are displaying in English.*
   - *To display an alternative language, select **Setup** from the main menu. Press the **Down** arrow repeatedly until "English" (or the appropriate language) appears. Then repeatedly press the **I/O enter** key to toggle through the languages. Once selected, all menus and measurement screens will change to the selected language. To return to the main menu, press the **Run/Stop** key.*
4. To return to the **main menu**, press and hold the **I/O Enter** key (3, 2, 1 countdown will appear) and the main menu will display.
   - To select an option on the main menu, press the **up or down arrow** until an arrow appears directly in front of the appropriate menu selection and then press **I/O enter** key.
5. To **power off**, press and hold the **I/O enter key** from the main menu.

Placement for Monitoring/Testing

The QUESTempº 34 & 36 model should be placed at a height of 3.5 feet (1.1m) for standing individuals or 2 feet (.6m) for seated individuals. Tripod mounting is recommended to get the unit away from anything that might block radiant heat or air flow. A 1/4"x 20 threaded bushing on the bottom of the instrument allows mounting to a standard photographic tripod. Do not stand close to the unit during sampling.

☑ ***NOTE:*** *Before measuring, allow 10 mins. for the sensors readings to stabilize.*

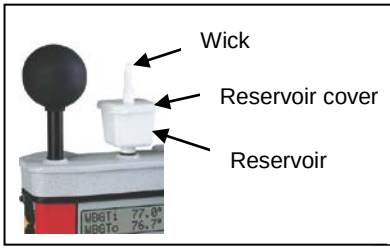
A. Globe thermometer
B. Natural wet bulb thermometer
C. Dry bulb thermometer

Natural Wet Bulb Thermometer

The natural wet bulb thermometer gives an indication of the effects of humidity on an individual. Relative humidity and wind speed are taken into account by measuring the amount of evaporative cooling taking place at a thermometer covered with a moistened wick.

Check Wick and Fill Natural Wet Bulb

The QUESTemp uses a cotton wick immersed into a reservoir containing distilled water. Ordinary tap water should not be used, as the contaminants that are left behind after evaporation will shorten the life of the wick and cause high readings. If the wick is discolored it should be replaced. To **replace the wick**, slide the old wick off the top of the sensor. Place a new wick over the sensor, making sure that the bottom of the wick is down in the reservoir.



Filling wet bulb reservoir

1. Remove reservoir cover and fill with distilled or de-ionized water.
2. Replace reservoir cover.

Figure 1-4: Filling wet bulb reservoir

Globe Thermometer

The globe thermometer (left position) gives an indication of the radiant heat exposure on an individual due to either direct sunlight or hot objects in the environment. This is accomplished by placing a temperature sensor inside a blackened copper sphere and measuring the temperature rise. The WBGT index is based on the response of a 6 inch diameter globe. The QUESTemp uses a 2 inch diameter globe for a faster response time. The temperature of the 2 inch globe is correlated to match that of a 6 inch globe.

Dry Bulb Thermometer

The dry bulb thermometer (right position) measures the ambient air temperature. This measurement is used in the outdoor WBGT calculation when a high solar radiant heat load may be present. The series of white plates surrounding the sensor shield it from radiant heat.

Relative Humidity Sensor

A relative humidity sensor is located in a compartment inside of the sensor bar housing. Slots in the housing allow air to circulate around the sensor.

Tri-sensor Calculation and Remote Cable

The top sensor bar (sensor 1) may be removed from the instrument and used through a remote cable. Shelter the instrument and remote the sensor bar if the measured environment is expecting heavy rain or if temperatures are above 60°C.

The sensor 2 and sensor 3 jacks on the side of the instrument allow simultaneous monitoring of up to three sensor arrays using connecting cables.

Cable lengths of up to two hundred feet (61 meters) may be used without a decrease in accuracy provided the environment does not contain strong electromagnetic fields. The data from these arrays may be viewed separately or combined into a weighted average WBGT reading per ISO 7243. Change the displayed sensor bar by pressing and releasing the enter key. The upper right corner of the display shows the current sensor bar. 1 refers to the top sensor bar, 2 and 3 are labeled on the side of the unit, W indicates the weighted average which only appears if a WBGT is displayed and all three of the sensor bars are attached.

Tri-sensor Weighted Average

Per the recommendations outlined in ISO 7243: 1989, when the temperature in the space surrounding a worker is not uniform, it is necessary to determine the WBGT index at three heights corresponding to the worker's ankles, abdomen and head and perform a weighted average on those values. It is computed using the formula:

WBGTw = (WBGT head + (2 x WBGT abdomen) + WBGT ankles) / 4

The QUESTemp° 36 always assigns the top sensor bar the double weighting. This calculation is shown if a WBGT display has been selected and if 3 sensor sets are connected.

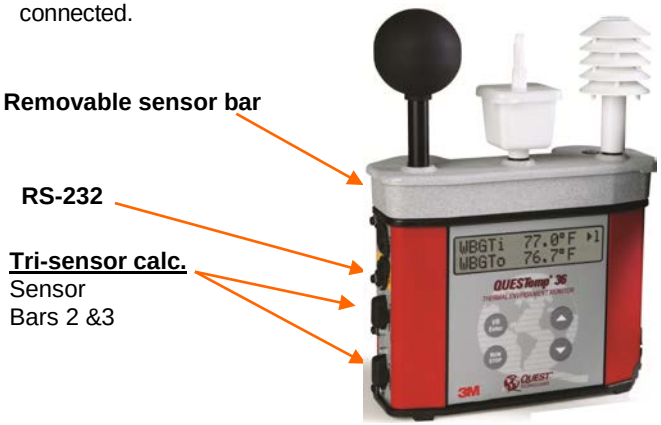


Figure 1-5: Ports identified

Measurements

The QUESTemp° 34 & 36 data logging area heat stress monitor directly senses the four parameters: ambient or dry bulb temperature (DB), natural wet bulb temperature (WB), globe temperature (G), and relative humidity (RH).

The QT° 34/ 36 compute the Wet Bulb Globe Temperature (WBGT), stay times for three possible indices (QT° 36 only), and the Heat Index (HI) or the Canadian Humidex. Using inputs on the side of the instrument, two additional sensor arrays can monitor up to three locations simultaneously.

On the QUESTempº 36 model, you can measure air flow, in meters per second, by plugging an optional hot wire anemometer sensor into a side jack on the unit.

Using Detection Management Software (DMS), you can determine the thermal comfort indices, Predicted Mean Vote (PMV) and Predicted Percent Dissatisfied (PPD) (with the QUESTempº 36 model only).

Wet Bulb Globe Temperature

The WBGT is a weighted average of the three temperature sensors, a globe thermometer, a wet bulb thermometer, and a dry-bulb thermometer, using the equations listed below.

WBGT (indoor) = 0.7WB + 0.3G (denoted as "WBGTi" on the display)

WBGT (outdoor) = 0.7WB + 0.2G + 0.1DB (denoted as "WBGTo" on the display)

The resulting WBGT values can then be compared to indices of work-rest regimens (stay times) based upon work loads.

Stay Times/Rest Times (QTº36 only)

Stay times represent how long a worker should be able to safely work under heat stress conditions (available on QUESTempº 36 only). Select one of the three indices for displaying and printing from the unit: ACGIH Stay Times, NAVY PHEL's, or EPRI Action Limits. (For setup, please refer to "Setup" on pages 9 -10. For detailed rest times please refer to charts in Appendix B.)

Heat Index/Humidex

The Heat Index is determined using the dry bulb temperature and relative humidity. Based upon charts available from the U.S. National Weather Service, Heat Index represents how an average person feels relative to climate conditions. For a given temperature, the higher the humidity, the higher the heat index.

The Heat Index is defined over a temperature range of 70°F - 120°F (21°C - 49°C) and a relative humidity range of 30% - 99%. Outside of this range, the instrument will show dashes in the display for the Heat Index.

The Humidex, used primarily in Canada, functions similar to the Heat Index concept. The values are slightly different. The Humidex is defined over a temperature range of 70°F - 109°F (21°C - 43°C) and a relative humidity range of 20% - 99%. Outside of this range, the instrument will show dashes in the display for the Humidex.

Air Flow

The QUESTemp° 36 measures air flow if the Air Probe accessory is used. The Air Probe uses an omni-directional anemometer sensor that measures air flow between 0 and 20 meters per second in 0.1m/s increments. Please see “Air Flow Functionality”, page 16 for more details.

Thermal Comfort (QUESTemp° 36 model only)

Thermal comfort readings for indoor environments are a benefit of DMS software and are not displayed or printed from the instrument directly. Readings are derived from the dry bulb, relative humidity, mean radiant temperature, air flow, and user entered parameters of clothing, metabolic rate and external work.

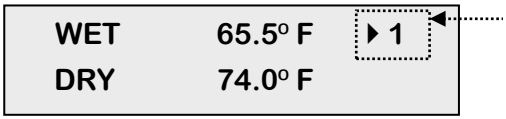
Thermal comfort indices, Predicted Mean Vote (PMV) and Predicted Percent Dissatisfied (PPD), help predict the thermal satisfaction level of a person with their indoor environment. The PMV is a rating scale of +3 to -3 where +3 is much to warm, -3 is much too cool, and 0 is thermally neutral. The PPD reflects what percent of people in a given location would be dissatisfied with their thermal surroundings.

The formulas used by DMS software to derive the PMV and PPD come from the international standard ISO 7730 “Moderate thermal environments - Determination of the PMV and PPD indices and specification of the conditions for thermal comfort”.

Use the **Up Arrow** and **Down Arrow keys** to move the marker in the display in front of the desired mode. Pressing the **I/O Enter key** will select the mode.

View

Displays the measured data but does not log it. If more than one set of sensors is plugged into the unit, these can be displayed by pressing and releasing the **I/O ENTER** key. The displayed **sensor set** is shown in the **upper right corner**.



View mode
Indicates you are viewing sensor one data

Figure 1-6: Viewing measured data

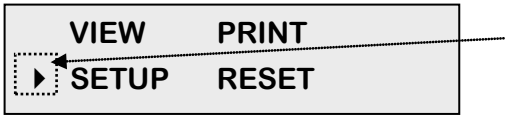
☑ ***NOTE:*** *To return to the menu, hold down the **I/O ENTER** key while a 3, 2, 1 countdown is shown in the lower right corner of the display. Then the menu screen will appear (see Figure 1-3, page 4 for an example).*

Setup

The setup screen is used to change the following parameters: temperature units, language, time, date, logging rate (QUESTemp° 36 only), selecting between Heat Index and Humidex, and setting stay time parameters.

➤ To Setup parameters do one of the following:

1. From the main menu, select **Setup** by pressing the **I/O Enter** key.



Setup selected

Figure 1-7: Setup selected in main menu

2. Use the **Arrow keys** to select an item (listed below).
   - **Temperature**: Celsius, Fahrenheit.
   - **Language**: English, Spanish, French, Italian, German.
   - **Time**: 24 hour clock only.
   - **Date**: Day-month-year format.
   - **Log Rate**: 1, 2, 5, 10, 15, 30, 60 minutes.
   - **Heat Index** (United States), **Humidex** (Canada)

- **Flow**: On, Off .
- **Index**: none, ACGIH, Navy, EPRI and select either: WBGTi (indoor), WBGTo (outdoor) for Index setting.

Index Settings	Explanation
TLV and action limit	These index settings only apply to the ACGIH Index. EPRI and Navy will ignore this setting.
Clothing Correction	Parameters are set from 0 - 9.9°C. This is a clothing correction for the WBGT in degrees Celsius and is applied to the selected WBGT when the work duration is calculated. (It will not affect the WBGT as displayed by the unit.) This value should typically be set to 0.0 for the Navy. (The field is noted as "Clo Corr".)

3. Press the **I/O Enter** key to change a parameter. Time and date require using the **Up/Down Arrows** and **I/O Enter** keys to modify each number.

   ☑ ***NOTE:*** *at any time, you can move back one level, by pressing the* ***Run/Stop*** *key.*

4. Exit Setup by pressing the **Run/Stop** key.

Print

QT°34/36 allows printing to a parallel or serial printer or to a computer. The QUESTemp° 36 will recognize the cable plugged in and configure itself for serial or parallel. If no cable is plugged in, it will default to serial. Press **I/O Enter** key to begin printing. Press **Run/Stop** key to return to the menu.

☑ ***NOTE:*** *if you wish to stop the printing, press I/O enter key until you return to the main menu. When the printer has stopped printing, remove the cable from the printer to the instrument.*

Reset

Resetting enables you to clear the logged data from memory. Press the **I/O Enter key** to enter the **Reset mode**. Clear the memory by holding down the **I/O Enter key** while the display counts down from three.

Run

The run mode begins a session in memory and logs the data.

1. Begin a session by pressing the **Run/Stop key** from the view mode (or measurement view). An asterisk in the lower right corner indicates the run mode.

   ☑ To toggle through the views, press the up or down arrow.

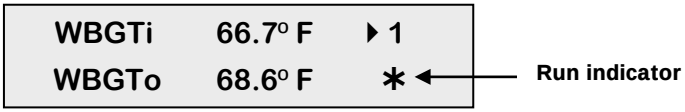


Figure 1-8: Run mode indicator

2. End the session by pressing the **Run/Stop key** again. (The session will stop recording when the asterisk is no longer displayed.)

☑ ***NOTE:*** *If the logging memory is full or if there are no sensors plugged into the unit, attempting to enter the Run mode will result in an error message. If the memory capacity is exceeded, the asterisk in the lower right corner of the display will turn into an "F" and the memory remaining screen will show "0.0".*

Displayed Items

For the QUESTemp° 34 & 36 models, the number in the upper right corner indicates which sensor bar's data is displayed.

- "**1**"indicates the sensor bar placed on (or attached to) the top of the instrument. Sensors 2 and 3 are labeled on the side of the unit as "Sensor 2", and "Sensor 3".
- **"W"** indicates the weighted average which only appears if a WBGT is displayed and all three sensor bars are attached. An asterisk in the lower right corner indicates that the unit is in the run mode and is logging data.

<u>The following measurements can be accessed on the display:</u>

Screen 1: WET (Wet bulb)
DRY (Dry bulb)

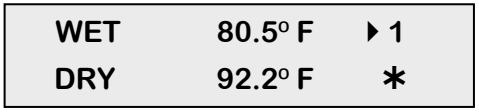


Figure 1-9 Wet and Dry screen

Screen 2: GLOBE

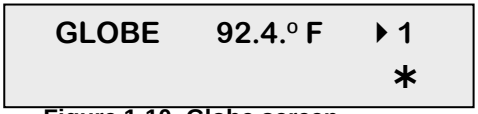


Figure 1-10: Globe screen

Screen 3: WBGTi (Indoors)
WBGTo (Outdoors)

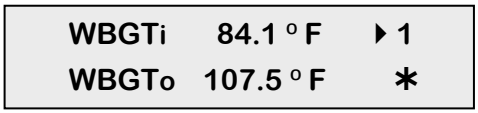


Figure 1-11: WBGTi & WBGTo screen

Screen 4: RH (Relative Humidity)
H.I. or HU
(Heat Index or Humidex)

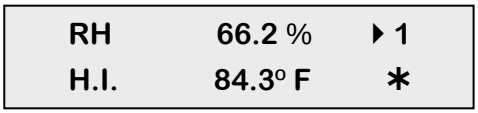


Figure 1-12: RH and H.I/HU screen

Screen 5: Air Flow
(If turned ON via setup
with QUESTempº 36 only)

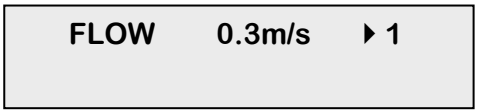


Figure 1-13: Air Flow screen

Screen 6: Stay times
(QUESTempº 36 only)

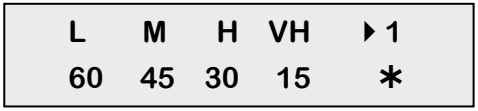


Figure 1-14: Stay times (ACGIH)

Screen 7: Time (24 hour format)
Date (day, month, year)

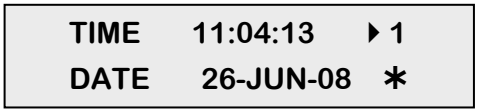


Figure 1-15: Time & Date screen

Screen 8: BAT (Battery voltage)
MEM (Logging memory
available in days)

Figure 1-16: Battery & Memory screen

☑ ***NOTE:*** A series of dashes appear in the display if one of the following occur:

- The Heat Index or Humidex is outside of its allowable range.
- The temperature is outside of its allowable range.
- A temperature sensor has failed.
- Stay times temperatures are outside of the defined range.

Stay Time

The screen(s) displaying stay time data appear different for each of the possible indices (available with QUESTemp° 36 model only).

If **ACGIH** is selected, the recommended working minutes per hour are shown for each of the workload categories Light (L), Moderate (M), Heavy (H), and Very Heavy (VH). (Please see Figure 1-14 above.)

If the **Navy PHELS** are selected, the recommended working hours are shown based on a maximum of eight hours. Three screens are used to display the PHELs two at time.

☑ ***NOTE:*** *"8:01" following one of the PHELs indicates greater than eight hours.*

Figure 1-17: Navy Stay time screen

If **EPRI** is selected, the recommended working hours are shown based on a maximum of four hours. Working hours for Light (L), Moderate (M), and Heavy (H) workload categories are displayed below.

☑ ***NOTE:*** *"4:01" indicates greater than four hours.*

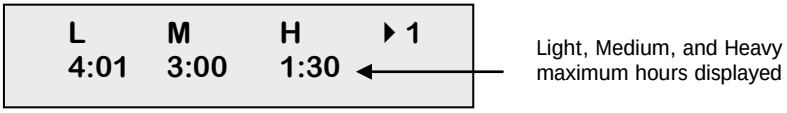


Figure 1-18: EPRI Stay time screen

Data Logging

Data from each sensor is recorded at the interval set by the logging rate (for QUESTemp° 34 & 36 models only). Every time **Run/Stop** is pressed, a session is either started or ended in memory. Each session contains a header with time, date, and summary information.

Memory Table: Gives the number of logging DAYS.

Log Rate	1 min	2 min	5 min	10 min	15 min	30 min	60 min
1 sensor	11.2	22.5	56.2	112.4	168.6	337.3	674.5
2 sensors	5.6	11.2	28.1	56.2	84.3	168.6	337.3
3 sensors	3.7	7.5	18.7	37.5	56.2	112.4	224.8

Table 1-1: Example of a Memory table

Printing

The recorded data can be sent to a computer through the serial RS-232 port or to a parallel printer. Serial transmission requires 3M cable #54-715. Parallel transmission requires 3M cable #56-875. With the cable plugged into the RS-232 auxiliary port, select **Print** from the menu and press the **I/O Enter key** to enter the **Print** mode. Begin printing by pressing the **I/O Enter key**. Press the key again to abort printing.

Serial

DMS software is recommended for downloading, storing, and graphing your data. Communications programs such as Window's HyperTerminal may also be used to capture the printout into a file. The baud rate is fixed at 9600.

Parallel

Data can be sent directly to parallel printers that accept direct ASCII test input without special drivers. Make sure the **printer** is **powered on** and is **online**, ready to accept data, prior to printing.

```
                              3M                                    Page 1
                              HEAT STRESS REPORT

File Name      _____________________________   Questemp 36  Rev 1.00
                                               Serial # TK09090909
Employee       _____________________________

Facility       _____________________________   Session (3)
                                               Start: 21-FEB-08  11:07:32
Department     _____________________________   Stop:  21-FEB-08  11:10:15

Job            _____________________________   Printed: 21-FEB-08  11:16:00

Comments/Notes_____________________________________________

_____________________________________________________________

Logging Interval:  1 minutes
Degrees Fahrenheit

MAXIMUM LEVELS,  Sensor 1
    WBGT IN       69.2    21-FEB-08  11:10:14
    WBGT OUT      68.3    21-FEB-08  11:10:08
    WET BULB      59.7    21-FEB-08  11:10:08
    DRY BULB      82.7    21-FEB-08  11:09:56
    GLOBE         91.4    21-FEB-08  11:10:12
    HEAT INDEX       0    00-XXX-00  00:00:00
    REL HUMIDITY   14%    21-FEB-08  11:07:32
    FLOW (m/s)     0.6    21-FEB-08  11:09:08

MAXIMUM LEVELS,  Sensor 2
    WBGT IN       81.2    21-FEB-08  11:10:06
    WBGT OUT      80.5    21-FEB-08  11:10:11
    WET BULB      70.5    21-FEB-08  11:10:11
    DRY BULB      99.2    21-FEB-08  11:09:07
```

Figure 1-19: Sample printout (page 1)

```
Session: 3                                                          Page 2
Sensor: 1
Degrees Fahrenheit
Stay Times: ACGIH, Acclimated, WBGTi, clo correction = 1.0 C

TIME  WBGTi WBGTo  WET   DRY  GLOBE  RH  HI  FLOW  L   M   H   VH
----- ----- ----- ----- ----- ----- --- --- ----- --- --- --- ---
11:08  68.7  67.9  59.4  82.4  90.7  13   0   0.5  60  60  60  60
11:09  69.0  68.1  59.5  82.6  91.3  12   0   0.5  60  60  60  60

Session: 3                                                          Page 3
Sensor: 2
Degrees Fahrenheit
Stay Times: ACGIH, Acclimated, WBGTi, clo correction = 1.0 C

TIME  WBGTi WBGTo  WET   DRY  GLOBE  RH  HI  L   M   H   VH
----- ----- ----- ----- ----- ----- --- --- --- --- --- ---
11:08  79.9  79.3  69.4  98.9 104.5  15   0  60  45  30  15
11:09  80.8  80.2  70.3  99.2 105.6  15   0  60  45  30  15

Session: 3                                                          Page 4
Sensor: 3
Degrees Fahrenheit
Stay Times: ACGIH, Acclimated, WBGTi, clo correction = 1.0 C

TIME  WBGTi WBGTo  WET   DRY  GLOBE  RH  HI  L   M   H   VH
----- ----- ----- ----- ----- ----- --- --- --- --- --- ---
11:08  68.6  68.1  58.3  88.0  92.7  11   0  60  60  60  60
11:09  68.8  68.4  58.6  88.3  92.9  11   0  60  60  60  60

Session: 3                                                          Page 5
Sensor: WBGT(W-AVG) = .50*WBGT(1) + .25*WBGT(2) + .25*WBGT(3)
Degrees Fahrenheit
Stay Times: ACGIH, Acclimated, WBGTi, clo correction = 1.0 C
       WBGTi  WBGTo
TIME   W-AVG  W-AVG  L   M   H   VH
-----  -----  ----- --- --- --- ---
11:08   71.5   70.8  60  60  60  60
11:09   71.8   71.1  60  60  60  45
```

Figure 1-20: Sample printout (page 2)

Air Flow functionality

(Available using 3M's Air Probe on QUESTemp° 36 model.)

Air flow is measured in meters per second over a range of 0 to 20m/s in 0.1m/s increments. The sensor should be placed or held perpendicular in the air stream. Unlike many anemometers, the omni-directional sensor does not require rotating to find the maximum reading. Be careful not to block the air flow with your body during measurements. The sensor's measuring tip is fragile; be cautious if measuring in ducts.

The Air Probe may be either hand held or mounted behind the QUESTemp° 36 using the mounting bracket hooked to the sensor bar beneath the center bulb sensor. (See Figure 1-21 below.)

A green lamp indicator in the Air Probe indicates that it is turned on and the battery is good. If the green indicator turns off while the switch is in the **On** position, replace or recharge the battery.

- To connect, follow steps 1-3 below.

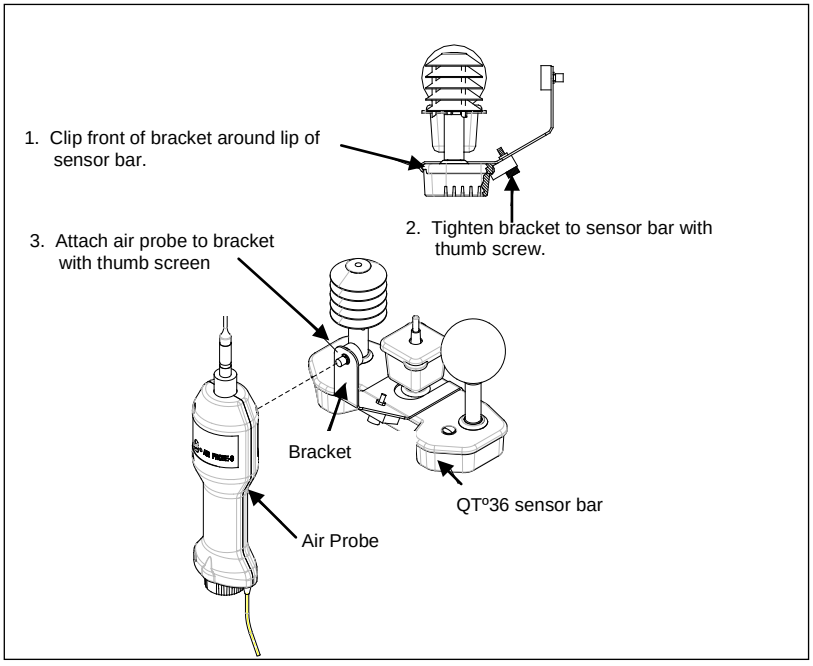

1. Clip front of bracket around lip of sensor bar.
2. Tighten bracket to sensor bar with thumb screw.
3. Attach air probe to bracket with thumb screen
Bracket
QT°36 sensor bar
Air Probe

Figure 1-21: Air flow configuration

Operating sequence

1. Turn **Flow On** in the setup menu of the QUESTemp° 36.
2. Plug the Air Probe into the port labeled **Flow** on the side of the QUESTemp° 36.
3. Turn on the Air Probe **ON** and make sure the green lamp is lit.
   - In the View or Run modes, air flow is displayed on the fifth screen.

Data Logging Air Flow

To data log air flow in the QUESTemp° 36, the following two conditions must be met.

1. First, turn **Flow On** in the setup menu.
2. Second, make sure that a temperature sensor bar is connected to the Sensor 1 location (top) of the QUESTemp° 36. Flow prints out with the Sensor 1 data therefore air flow data will only be reported if a sensor bar is plugged in. Air flow is recorded during the run mode at the interval the QUESTemp° 36 is setup for.

Batteries for Air Probe

The Air Probe uses a single NiMH Black&Decker® VersaPak™ Gold battery. Typical operating time of the battery is between 6 and 8 hours.

To change the battery, push in and twist, counterclockwise, the cap on the bottom of the Air Probe. Pull out the battery. Insert a fully charged battery and replace the cap.

To recharge the batteries, set the battery into the VersaPack™ charger. The supplied charger accepts one or two batteries. A full charge takes 9 hours. An indicator light shows that the battery is properly charging and it will remain on as long as the battery is in the charger. Continuous charging is not a safety concern.

Operational Check

A verification module, 3M model 053-923, may be used to check the operation of the QUESTemp. Remove the top sensor bar and plug the verification module into the top of the unit. With the QUESTemp set to read in degrees Celsius, verify that the displayed readings match those printed on the module within +/-0.5°C.

If the readings are not within the +/-0.5°C tolerance, then have the unit serviced and calibrated.

Power options

There are 3 options for powering the QUESTemp° 36: a 9-volt alkaline battery, a NiMH (Nickel Metal Hydride) rechargeable 6-cell battery pack, and an AC adapter. A door on the back of the unit allows the user access to the 9-volt battery. The rechargeable battery pack is located inside of the unit. If the rechargeable battery pack ever needs to be replaced, it can be accessed by removing the screws from the bottom panel of the unit.

The 2-position switch located in the battery compartment must be set by the user if the power supply method is changed. The up position is for the 9-volt battery. The down position allows for either the AC adapter or the rechargeable batteries. The AC adapter will trickle charge the rechargeable batteries if they are in place or it will simply allow for line power operation of the unit.

Figure 1-22: 9-volt battery

9-Volt Alkaline Battery Replacement

WARNING: Replace batteries only in a non-hazardous environment.

The 9-volt battery should be replaced or the NiMH battery pack should be recharged when the voltage drops below 6.4 volts. The battery voltage is displayed when the instrument is turned on. While turned on, the battery voltage can be displayed at any time by pressing the up or down arrow keys to move through the display until the battery voltage screen appears. If, while operating, the battery voltage drops below 6.4 volts, the display will automatically switch to the display showing the battery voltage along with a low battery message. After a low battery occurs, the unit will continue to operate for approximately 8 hours. When the battery voltage falls to 6.2 volts or below, the unit will automatically turn off.

Replace only with an approved 9-volt alkaline battery.

Approved 9-Volt Batteries

Eveready: Energizer 522, EN22, 6LR61
Duracell: MN1604
Panasonic: 6LR61, 6AM6X
Rayovac: A1604
UltraLife:U9V

NiMH Battery Pack

WARNING: Recharge batteries only in a non-hazardous environment.

The NiMH rechargeable battery pack is charged in the instrument using 3M's AC 120V AC to 9V DC adapter (part #015-910) or 220V AC to 9V DC adapter (part #015-680). A discharged battery pack requires an "overnight" charge of 16 hours (for the 120V adapter). Leaving the AC adapter plugged in for extended lengths of time or when operating the instrument will not harm the rechargeable batteries.

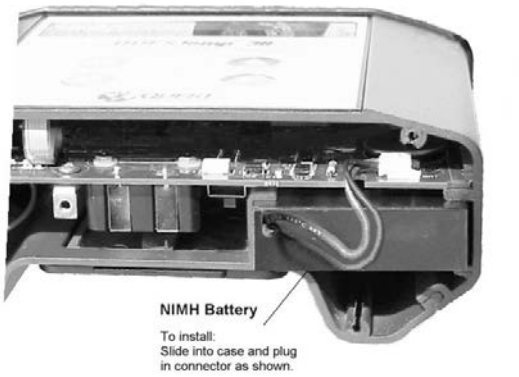


Figure 1-23: NiMH rechargeable battery

Appendix A: Specifications

Measurements

Globe temperature, dry bulb temperature, wet bulb temperature, % relative humidity, WBGTin, WBGTout, WBGT weighted average (if 3 sensor sets), and Heat Index / Humidex.

Temperatures given in Celsius or Fahrenheit.

Data Logging

Records and prints all measurements at user selected interval of 1, 2, 5, 10, 15, 30, or 60 minutes. 128K bytes of data memory.

Languages

- English, French, Spanish, Italian, German

Housing

Designed water resistant to a light rain or mist. If rain is frequent, best practice would be to remote the sensor bar and keep the instrument sheltered.

Size

- Height 9.2in (23.5cm); Width 7.2in (18.3mm); Depth 3.0in (7.5mm)
- Dimensions include mounted sensor assembly

Weight

- 2.6 lbs. (1.2 kg) with mounted sensor assembly

Sensor Types

- Temperature: 1000 ohm platinum RTD
- Humidity: Integrated circuit with capacitive polymer sensor

Accuracy

- Temperature: +/-0.5°C between 0°C and 120°C
- Relative humidity: +/- 5% between 20 to 95% (non-condensing)

Operating Temperature Range

- Sensor Assembly: -5°C to +100°C
- Electronics: -5°C to 60°C

Remote Sensor Bars

2 x 15pin D-sub jacks are located on the side of the unit for plugging in 1 or 2 additional sensor bars by using remote cables up to 200 feet (61m). The top sensor bar can also be remote with a cable.

Power Options

9V alkaline, 7.2V NiMH rechargeable pack (charged in the unit), or AC adapter wall power cube (AC adaptor will operate the unit or recharge the NiMH battery pack)

Battery Life

9V alkaline: 140 hours
Rechargeable Nickel Metal Hydride: 300 hours
(Adding additional sensor bars reduces battery life.)

Charge Time (NiMH Battery Pack)

- 16 hours (charge in the unit)

Air Probe Accessory (QUESTemp° 36 model only)

Range

0 - 20 meters per second. 0.1m/s increments

Sensor

Omni directional heated thermistor

Accuracy

+/- (0.1 m/s + 4%) of measurement value

Battery Life

6 - 8 hours for fully charged NiMH battery

Charge Time

9 hours

Product markings and special conditions

KEMA 04ATEX1072 X
<Ex> II 2 G EEx ia IIC T3

Compliance with Essential Health and Safety Requirements has been assured by compliance with: EN 50014 : 1997 and EN 50020 : 2002

The year of manufacture is determined by the third character in the instrument's serial number. "A" was manufactured in 2000, "B" in 2001, "C" in 2002, "I" in 2009 and so forth.

Special conditions for safe use:

1. Only the following battery types may be used:
   - **Non-rechargeable battery:**

Type	Manufacturer
U9V	Ultralife
MN1604	Duracell
522 or EN22 or 6LR61	Energizer
A1604 or BR232	Rayovac
6LR61 or 6AM6	Panasonic

   - **Rechargeable battery:**
     Integral NiMH battery pack type DC2121

2. The batteries may not be replaced or charged within the hazardous area.

3. The rechargeable battery may only be recharged with class 2 charger, rated 9Vdc, 1 A max.

4. The plugs or sockets market "SENSOR 2", "SENSOR 3", "FLOW", and "DATA" may not be used within the hazardous area.

Appendix B: Heat Exposure Tables

ACGIH

Screening Criteria for Heat Stress Exposure. WBGT values in °C. *NOTE: according to the ACGIH's guidelines, the temperature values represent a work and rest process which is explained in the standards. Please refer to the ACGIH TLVs and BEIs for specific details.*

Work and recovery (TLV)	**Light**	**Moderate**	**Heavy**	**Very Heavy**
75% to 100%	31.0	28.0	26.0*	23.5*
50% to 75%	31.0	29.0	27.5	25.5*
25% to 50%	32.0	30.0	29.0	28.0
0% to 25%	32.5	31.5	30.5	30.0

Work and recovery (Action Limit)	**Light**	**Moderate**	**Heavy**	**Very Heavy**
75% to 100%	28.0	25.0	22.5*	20.0*
50% to 75%	28.5	26.0	24.0	22.5*
25% to 50%	29.5	27.0	25.5	24.5
0% to 25%	30.0	29.0	28.0	27.0

*Values not specified by ACGIH have been estimated for continuity.

Cited from American Conference of Governmental Industrial Hygienists, *Threshold Limit Values and Biological Exposure Indices for 2008*. Reprinted with permission.

ACGIH Clothing Corrections

The following clothing corrections are in degrees Celsius. When a clothing correction is entered into the setup portion of the QUESTemp° 36, the value is added to the WBGT only for looking up the stay times. The WBGT value displayed by the unit does not reflect corrections.

Clothing type	Clothing correction (Addition to WBGT (ºC)
Work clothes (long sleeve shirt and pants)	0º
Cloth (woven material) coveralls	0º
Double-layer woven clothing	3º
SMS polypropylene coveralls	0.5º
Polyolefin coveralls	1º
Limited-use vapor-barrier coveralls	11º

Cited from American Conference of Governmental Industrial Hygienists, *Threshold Limit Values and Biological Exposure Indices for 2008*. Reprinted with permission.

United States Navy

Physiological Heat Exposure Limits (PHEL) Time Table
(Without the presence of fuel combustion gases/fuel vapors)

The recommended working hours are shown based on a maximum of eight hours. Naval personnel will follow a category, I - VI, based upon their function.

PHEL Curves (Total Exposure Time in Hours: Minutes)

WBGT(F)	I	II	III	IV	V	VI
80.0	>8:00	>8:00	>8:00	8:00	6:35	4:30
81.0	>8:00	>8:00	>8:00	8:00	6:35	4:30
82.0	>8:00	>8:00	8:00	7:05	5:25	3:40
83.0	>8:00	8:00	7:45	6:25	4:55	3:20
84.0	>8:00	8:00	7:05	5:55	4:30	3:05
85.0	8:00	7:45	6:30	5:20	4:05	2:50
86.0	8:00	7:05	5:55	4:55	3:45	2:35
87.0	7:25	6:30	5:25	4:30	3:25	2:20
88.0	6:45	5:55	4:55	4:05	3:10	2:10
89.0	6:10	5:25	4:30	3:45	2:50	2:00
90.0	5:40	5:00	4:10	3:25	2:40	1:50
91.0	5:15	4:35	3:50	3:10	2:25	1:40

Appendix B: Heat Exposure Tables

WBGT(F)	I	II	III	IV	V	VI
92.0	4:50	4:10	3:30	2:55	2:15	1:30
93.0	4:25	3:50	3:15	2:40	2:00	1:25
94.0	4:05	3:35	3:00	2:25	1:50	1:15
95.0	3:45	3:15	2:45	2:15	1:45	1:10
96.0	3:25	3:00	2:30	2:05	1:35	1:05
97.0	3:10	2:45	2:20	1:55	1:25	1:00
98.0	2:55	2:35	2:10	1:45	1:20	0:55
99.0	2:40	2:20	2:00	1:40	1:15	0:50
100.0	2:30	2:10	1:50	1:30	1:10	0:45
101.0	2:20	2:00	1:40	1:25	1:05	0:45
102.0	2:10	1:50	1:35	1:15	1:00	0:40
103.0	2:00	1:45	1:25	1:10	0:55	0:35
104.0	1:50	1:35	1:20	1:05	0:50	0:35
105.0	1:40	1:30	1:15	1:00	0:45	0:30
106.0	1:35	1:25	1:10	0:55	0:45	0:30
107.0	1:30	1:15	1:05	0:50	0:40	0:25
108.0	1:20	1:10	1:00	0:50	0:35	0:25
109.0	1:15	1:05	0:55	0:45	0:35	0:25
110.0	1:10	1:00	0:50	0:40	0:30	0:20
111.0	1:05	1:00	0:50	0:40	0:30	0:20
112.0	1:00	0:55	0:45	0:35	0:25	0:20
113.0	0:55	0:50	0:40	0:35	0:25	0:15
114.0	0:55	0:45	0:40	0:30	0:25	0:15
115.0	0:50	0:45	0:35	0:30	0:20	0:15
116.0	0:45	0:40	0:35	0:25	0:20	0:15
117.0	0:45	0:40	0:30	0:25	0:20	0:10
118.0	0:40	0:35	0:30	0:25	0:15	0:10
119.0	0:35	0:35	0:25	0:20	0:15	0:10
120.0	0:35	0:30	0:25	0:20	0:15	0:10
121.0	0:35	0:30	0:25	0:20	0:15	0:10
122.0	0:30	0:25	0:20	0:15	0:15	0:10
123.0	0:30	0:25	0:20	0:15	0:10	0:10
124.0	0:25	0:25	0:20	0:15	0:10	0:05

Electrical power research institute (EPRI)

The recommended working hours are shown based on a maximum of four hours. A time of 4:01 indicates greater than 4 hours.

WBGT°C	Light	Moderate	Heavy
28	4:01	4:01	3:00
29	4:01	4:00	2:00
30	4:01	3:00	1:30
31	4:01	2:00	1:15
32	4:00	1:30	1:00
33	3:30	1:15	0:45
34	3:00	1:00	0:40
35	2:30	0:53	0:35
36	2:00	0:45	0:30
37	1:45	0:40	0:25
38	1:30	0:35	0:20
39	1:15	0:33	0:18
40	1:00	0:30	0:15
41	0:53	0:28	0
42	0:45	0:25	0
43	0:38	0:23	0
44	0:30	0:20	0
45	0:28	0:18	0
46	0:25	0:15	0
47	0:23	0	0
48	0:20	0	0
49	0:18	0	0
50	0:15	0	0

Appendix C: Accessories

Sensor array with 2 inch globe	56-795
Sensor array with 6 inch globe	56-780
6 Foot shielded remote sensor cable	53-924
25 Foot shielded remote sensor cable	53-925
100 Foot shielded remote sensor cable	53-926
200 Foot shielded remote sensor cable	53-927
Serial computer cable	54-715
Parallel printer cable	56-875
120VAC to 9VDC adapter	15-910
220VAC to 9VDC adapter	15-680
Verification module	53-923
Tripod	59-045
Replacement wicks	56-679
Water bottle 2 oz.	56-068
User's manual	56-663

Air Probe Accessories

NiMH battery	53-039
Dual 120 volt charger	53-037
Dual 220 volt charger	53-038

Appendix D: Detection Management Software DMS

The QUESTemp° 34/36 has the flexibility to communicate, download data, create reports, and save customized setups using the 3M™ Detection Management Software DMS.

DMS Quick overview

The focus of this section is to briefly explain how to download, create quick reports, and a quick overview of setup parameters. (Please refer to the DMS User Manual for further instructions.)

Downloading your sessions in DMS

Once the QUESTemp° 34/36 is communicating and run/stops are stored on the instrument, this data may be downloaded into DMS for further analysis and reporting.

➢ **Downloading your sessions**

1. Download the DMS software. (Note: you may have purchased this with your instrument.)
2. Using a 3M cable, part number 054-715, plug the cable into the computer and plug the opposite end into the side jack of the QT°34/36 data port.

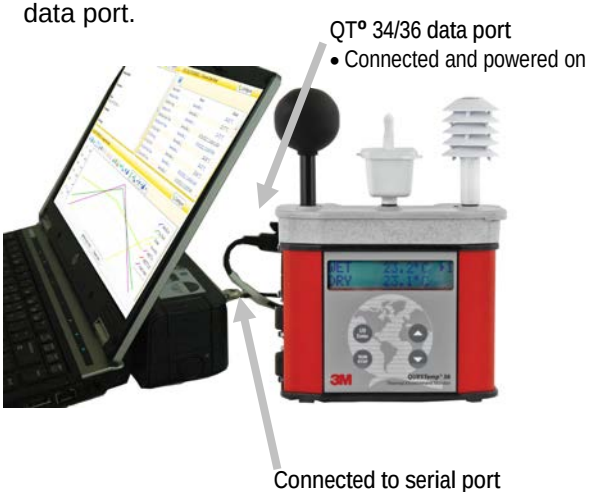


Figure 1-24: Communicating to DMS

3. Power on the QUESTempº 36 by pressing and holding the **I/O Enter** key.

4. Open DMS and click on

button.

5. Select **Heat Stress** and then select the **Model Type** by clicking on QTº34 or QTº36. (See 1 and 2). (You are now ready to setup or download your instrument.)

6. Click in the **Data Finder** checkbox (see 3) and then select

button (see 4).

   - ***Note:*** When downloading, DMS will state it successfully received the files (at the bottom of the page). It will then open the Data Finder Page.

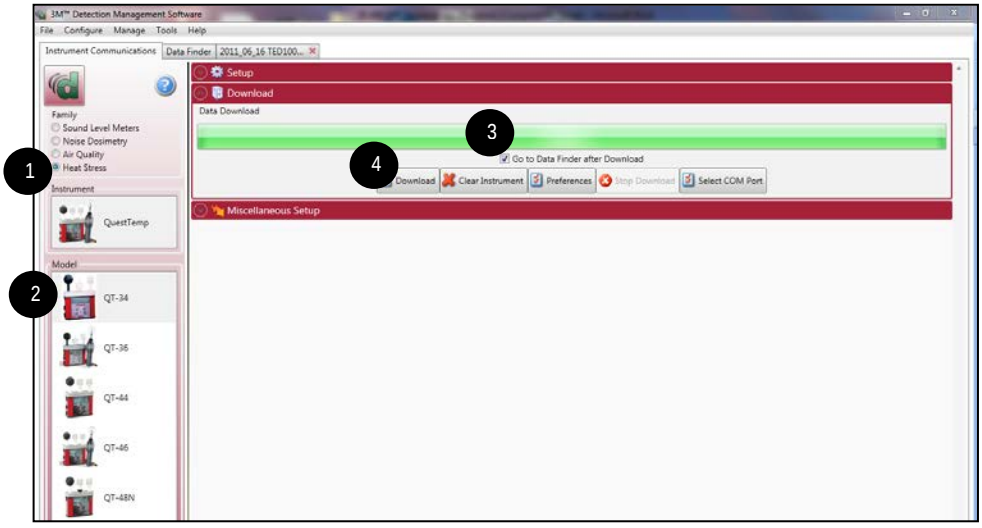


Figure 1-25: Downloading with the QTº34/36

Viewing/Analyzing and Quick Reporting in DMS

In the Data Finder page, your heat stress data is stored by instrument family and then by model. There are two options in the data finder page which include analyzing and printing a quick report. Please see below for more details.

➢ Analyze data

1. In the Data finder page, click a heat stress session by expanding the Family heat stress and selecting the session.
   - ***Note:*** to view the recently downloaded data, click on Recent and then select the session by looking at the Start Time/Date field.

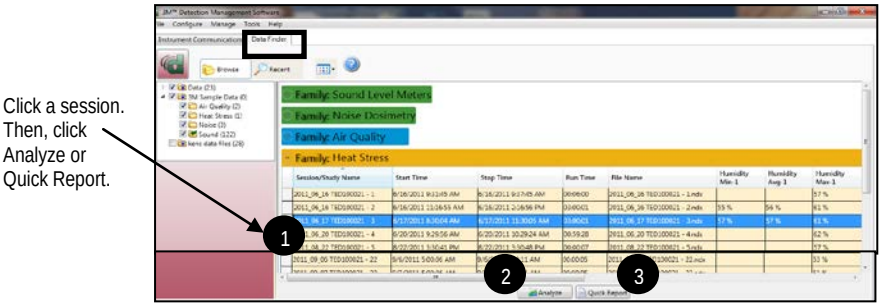


Figure 1-26: Data Finder page (Analyze/Quick Report options)

2. The session page layout will appear.
   - Work items (A) – select either the session or study (in order to view appropriate data).
   - Add panel (B) – double-click on a chart/table type and it will appear as a panel on your screen.
   - Arrange panels (C) – displays the displays the order of the charts/tables which appear in the panel layout. Also, when a chart/table is selected in the arrange panels palette, the associated data panel is selected. The resize handles are applied and the panel is brought into view allowing you to resize/reposition. To delete a panel, right-click on a chart/table and press delete from your keyboard.
   - Data Panels (D) – used to view your measurement and/or parameters from your study.

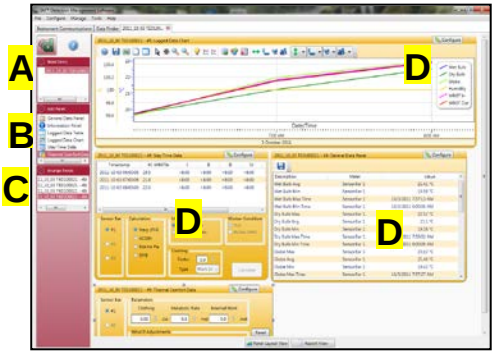


Figure 1-27: Data layout page (displays your data in charts and graphs)

Reporting and Printing

If you are in the Data finder page, you have the option to select Quick Report button and this will give you a report instantaneously using a standard template of graphs and charts (also called panels.).

- Viewing reports: if you are in the data layout page and you have rearranged the charts/tables, the report will print in the sequence in which they appear on the screen.
- Printing reports: while in the report view page you have two options outlined below:
- Click on the icon from the title bar.
- Click on the Print icon from the session report title bar.

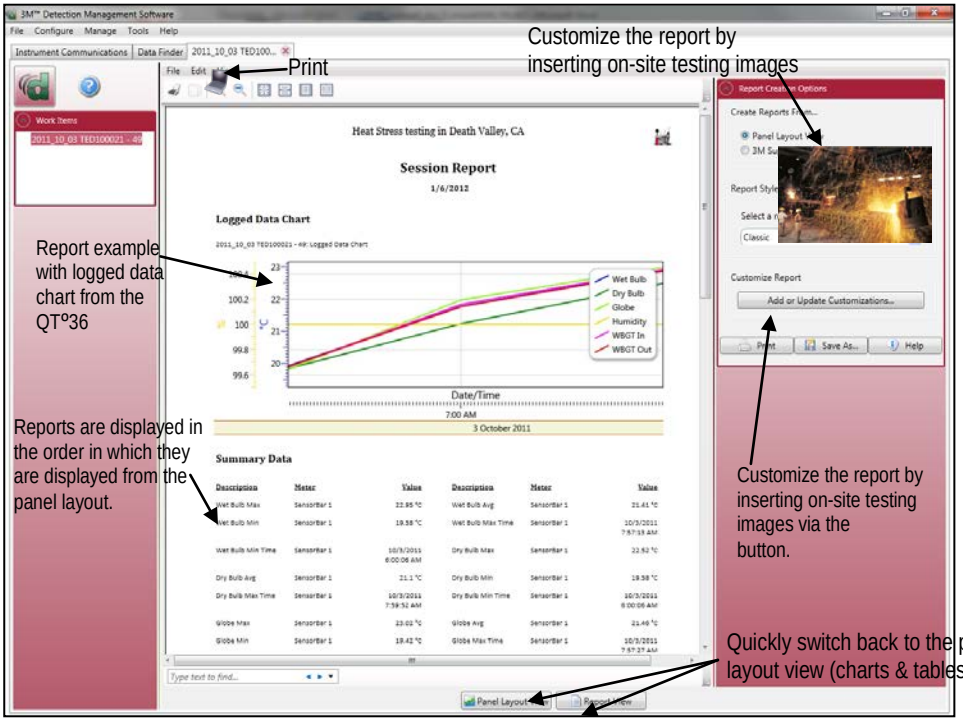

Print
Customize the report by inserting on-site testing images
Report example with logged data chart from the QT°36
Reports are displayed in the order in which they are displayed from the panel layout.
Customize the report by inserting on-site testing images via the button.
Quickly switch back to the panel layout view (charts & tables)
Heat Stress testing in Death Valley, CA
Session Report
1/6/2012
Logged Data Chart
Summary Data

Figure 1-28: Reporting and printing

Customer service

Contacting 3M Instrumentation

Should your 3M equipment need to be returned for repair or for recalibration, please contact the service department at the following number or access the online form via the website. For technical issues, please contact Technical Support.

Service Department and Technical Support: 1 (800) 245-0779.
Fax: 1 (262) 567-4047. Office hours are 8:00 a.m. to 5:00 p.m. United States Central.
E-mail: 3Mdetectionmail@mmm.com
Website: www.3M.com/detection

International customers

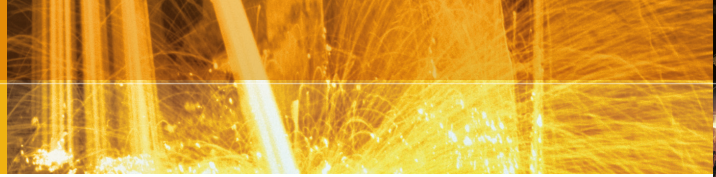
Contact your local, factory-authorized distributor from whom the product was purchased. You can obtain the name and contact information of your local factory-authorized distributor from 3M by using the e-mail, telephone, or fax information given under “Contacting 3M” above.

Calibration

The QUESTemp° 34/36 and 3M field calibrator devices should be examined regularly by the factory. An annual calibration is recommended. (Please see Service Department above.)

Warranty

3M warrants our instruments to be free from defects in materials and workmanship for one year under normal conditions of use and service. For United States customers, we will replace or repair (our option) defective instruments at no charge, excluding batteries, abuse, misuse, alterations, physical damage, or instruments previously repaired by other than 3M. Microphones, sensors, printers, and chart recorders may have shorter or longer warranty periods. This warranty states our total obligation in place of any other warranties expressed or implied. Our warranty does not include any liability or obligation directly resulting from any defective instrument or product or any associated damages, injuries, or property loss, including loss of use or measurement data.
For warranty outside the United States, a minimum of one year warranty applies subject to the same limitation and exceptions as above with service provided or arranged through the authorized 3M distributor or our 3M European Service Laboratory. Foreign purchasers should contact the local 3M authorized sales agent for detail.



About Us

3M Detection Solutions is a world class manufacturer of rugged, reliable instrumentation and software systems that help monitor and evaluate occupational and environmental health and safety hazards, including noise dosimetry, sound level monitoring, heat stress, indoor air quality and select toxic/combustible gases. The 3M Detection brand of instrumentation is used by safety and industrial hygiene professionals to help comply with applicable occupational standards and regulations.

About 3M Personal Safety

3M offers a comprehensive, diverse portfolio of Personal Safety solutions providing respiratory protection, hearing protection, fall protection, reflective materials for high visibility, protective clothing, protective eyewear, head and face protection, welding helmets, and other adjacent products and solutions such as tactical safety equipment, detection, monitoring equipment, active communications equipment and compliance management. In 2012, 3M celebrated 40 years of safety leadership – recognizing the company's respiratory and hearing protection solutions introduced in 1972. Visit www.3M.com/PPESafety or http://m.3m.com/PPESafety for details.

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Oconomowoc, WI 53066
ISO 9001 Registered Company
ISO 17025 Accredited Calibration Lab
Customer Service: 262-567-9157
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www.3m.com/detection

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